Chapter XVIII
Emergence of Analogies in Collaboratively Conducted Computer Simulations

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ABSTRACT

To learn by means of analogies, students have to see surface and deep structures in both source and target domains. Educators generally assume that students, presented with images, texts, video, or demonstrations, see what the curriculum designer intends them to see, that is, pick out and integrate information into their existing understanding. However, there is evidence that students do not see what they are supposed to see, which precisely inhibits them to learn what they are supposed to learn. In this extended case study, which exemplifies a successful multimedia application, 3 classroom episodes are used (a) to show how students in an advanced physics course do not see relevant information on the computer monitor; (b) to exemplify teaching strategies designed to allow relevant structures to become salient in students' perception, allowing them to generate analogies and thereby learn; and (c) to exemplify how a teacher might assist students in bridging from the multimedia context to the real world.

INTRODUCTION

Multimedia have shown to increase learning opportunities, both in face-to-face and distant, asynchronous collaborative settings (e.g., Hwang, Wang, & Sharples, 2007; Shih, Wang, Chang, Kao, & Hamilton, 2007). However, few researchers in educational multimedia research ask themselves whether students actually perceive what designers intend them to see. Although it was an innovation in the 1960s (Hanson, 1965), it now is a platitude to state that all observation is theory laden. Yet most educators still have not drawn the radical consequences that derive from this statement.

Thus, although many science educators (especially those with a constructivist penchant), for example, will claim that they take into account students' current views and understandings, they nevertheless use demonstrations and modeling software with the assumption that students will see science concepts in actions. Taking the theory-laden nature of observation seriously means that we expect students to observe phenomena that are very different from what scientists observe, so that precisely that which is scientific in some demonstration is *not* available to students who bring their everyday, common sense, frequently Aristotelian understanding to bear on observational tasks. Yet we also know that (at least some) students can and do eventually see certain events (demonstrations, laboratory experiments) in scientific ways. A key question for instructional designers must be what the roles of teachers and computing technology may be in mediating students' access to phenomena such that their everyday ways of seeing them change to making scientific observations. In other words, because seeing and perceiving are central to any form of cognition, because these processes provide the materials that cognitive agents work with, I am interested in understanding the role teachers and computing technology might be in the transformation of everyday to scientific ways of seeing, and, simultaneously, in the transformation of everyday into scientific ways of understanding certain phenomena. The purpose of this chapter is to show how through the use of multimedia, students can be stimulated into seeing the crucial aspects of some phenomenon that allows them to learn by means of analogies: this involves as a crucial element the fact that students need to identify deep structures in their common sense ways of seeing and understanding that also are valid in the scientific ways of seeing and understanding. The learning context that I use to exemplify my point is a collaborative setting where students and teacher use computer-based simulations of physical phenomena. Of special interest to this research are student–teacher transactions and how these mediate student perception, teacher assessment, and teacher intervention.

BACKGROUND

In this study, I report and analyze ongoing classroom conversations that occur over and about computer simulations, teacher-student transactions, and the emergence of productive analogies from teacher-student-computer transactions. Although the students begin with seeing physical phenomena (produced by a simulation on a computer monitor) in non-scientific ways, they eventually come to see them, as a result of the particular configuration, to see them in scientific ways. They do so by producing analogies that constitute bridges to scientific ways of seeing and understanding. Analogies, however, constitute double-edged swords, as they require and are based on the identification of common structures in some source (base) domain and the target (scientific) domain. But the second domain precisely is unknown to students. In this section, I briefly

Analogical Learning

Analogies have shown to be powerful tools for learning in science (Duit, 1991) or to provide cognitive support for learning in mathematics classrooms (Richland, Zur, & Holyoak, 2007). An analogy requires aspects of a source domain to be transferred (and likened) to a target domain (Gentner, 1989). Learning occurs as students become aware of the similarities in the two domains; this awareness can be used productively in the mutual elaboration of both source and target domains. For this to occur, however, students need to recognize deep structures; researchers have come to understand that the failure to learn through analogies lies in the fact that students do not perceive the deep structures in the two domains (Duit, Roth, Komorek, & Wilbers, 2001). That is, as these authors point out, analogical learning

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